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Operation Code

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1 PRINCIPLES OF THE OPERATION OF INTERCONNECTED POWER SYSTEMS

J.[1] Even though each **TSOs** has a perfect knowledge of the operation techniques, the interconnected operation requires the reference to some principles that it is helpful to state and assume as in common reference. Above all, this Chapter aims at avoiding misunderstandings about the scope covered by the code and the responsibilities. A minimum but real harmonization of rules, tools and technical levels is behind this Chapter.

1.1 Object and Scope

Object of this code is the operation of the **International Interconnections** in the Pan Arab Region.

The operation of the tie lines and the portion of the **Transmission Systems** at the borders, affecting the cross-border and **Bidding Zones TTC** are part of this **Code**. Other aspects of the operation related to internal matters are regulated by the relevant **National Grid Codes.**

Aspects of the **National Grid Codes** affecting the interconnection shall be harmonized by the involved **TSOs.**

1.2 Responsibility

TSOs are responsible for the security of supply, security and economy of operation of the **Electricity Systems,** under their competence in any stage of operation. The responsibility concretely materializes in the decisions they take in the last phases of the operational planning and in real time.

TSOs are responsible for the effects of operation of their own systems against the other **TSOs** as far as balancing and the **Relevant Grid** (**RG**) are concerned.

1.3 Solidarity, reciprocal support, mutual trust and cooperation

J. The cooperation in an interconnected framework can be carried out with a variety of attitudes and mind-sets. This code requires that Members shall operate their Electricity Systems with spirit of cooperation, fairness, and solidarity, showing readiness to mutually support each other.

TSOs shall operate their **Transmission Systems** to pursue the technical advantages of the interconnected operation, complying with the security of operation standards of this **Code** and to create the best conditions for cross-border energy trading according to the **General Agreement**. To this purpose, each **TSO** shall:

a) Use all internal resources to avoid spreading to the rest of the **Interconnected Members** any contingency occurred in its **Electricity System**.
b) Bring back the cross-border **Energy Transfers** as soon as possible, but not later than a given time to the scheduled values, when imbalances occur in its **Electricity System**.

[1] J.: Justification

c) Keep the **International Interconnections** as much as possible in operation and shall agree on dedicated procedures to open HVAC tie lines and **HVDC Systems**, both in normal and emergency conditions.

1.4 Requirements

Despite the advantages that interconnection brings to the **PAEM Electricity System** in terms of strength and to the markets in terms of competition for the ultimate benefit of the citizens, the **Member States** shall use their **Best Effort** for reaching the highest levels of interoperability and a comparable rank of technical quality in controlling their **Electricity System,** in organization, skills and adopted tools.

1.5 Relations with Central Entities

If in a **Sub-Region** or a **Synchronous Area**, a central entity with the role of **Regional Coordination Entity**, that is a **Sub-Regional TSO/Market Facilitator** as defined in **General Agreement** in Section 3.6, has been established, **TSOs** continue to be responsible for the operation against the rest of **TSOs** outside the **Sub-Region** and of the application of this **Code**, without prejudice of Article 3.6.2 of **General Agreement**.

As per Section 3.6 and 3.8 of the General Agreement, the responsibilities against the **TSOs** belonging to the same **Sub-Region** and sharing the same **Sub-Regional TSO/Market Facilitator,** are regulated by the regulations of the **Sub-Regional TSO/Market Facilitator.** In such conditions, **TSOs** shall make aware in writing the rest of **TSOs** of the rules governing the **Regional Market Facilitator** and the parts of operation performed by the **Regional Market Facilitator** on behalf of the **TSOs**.

1.6 Policies on Security of Operation (SO)

1.6.1 General Concepts

The **Security of Operation** (**SO**) is the precondition to guarantee a seamless development of the **PAEM** and the quality of supply needed for the welfare of the Pan-Arab region. **TSOs** guarantee the security of operation according to standards compliant with **Security Policies** commonly agreed to in this **Code**.

SO shall be independent of the adopted market regimes. Security standards shall depend on the physical characteristics of the assets and the capability of the **TSOs** for controlling their **Electricity Systems**. Market objectives shall never induce the **TSOs** to infringe the **SO** rules.

TSOs shall never use the **SO** rules to favor any **Market Participant**. **Sub-Regional TSOs/Market Facilitators** may adapt the application of the **SO** rules of this **Code** to the peculiarities of their **Sub-Regions**, as long as they are isolated **Synchronous Areas**. Such peculiarities include the degree of development of the interconnection, the criticality of the electricity services and the development phase in which the region lies in a given period. The conditions and the adaptations of the security rules must be made known to the **TSOs**.

Procedures for security assessment shall be agreed at **Synchronous Area** level or sub-regional level. As a norm:

a) Steady state load flow analysis should be adequate for routinely and systematic applications.
b) **Dynamic Security Assessment** (**DSA**) studies are recommended and confirmed at regional level, at least for periodical verifications. DSA is recommended in situations where the **Electricity Systems** are extremely unloaded, and sources are far from loads.
c) Short circuit studies are requested at least yearly or in particular cases in protection setting activity.

1.6.2 Gradual Compliance

TSOs, which are not complying with the requirements of this **Code,** can self-certify their incompliances and start a plan for bridging the gap between the current situation and the fully compliant status.

Therefore, and in the spirit of a harmonic growth of the interoperability, **TSOs** accept a regulated **Compliance Monitoring** (**CM**) process to check the degree of implementation of the **Security Policies** and the progress towards full compliance.

Pursuant to Paragraph 3.3.1.3 of the **GA**, the **Pan-Arab ARC** supported for the technical aspects and auditing activities by the **Arab TSOs Committee** shall perform the compliance assessments as per Paragraph 3.3.1.5 of **GA.**

1.7 Adoption of The Operation Code, derogations and compliance rules

TSOs, any **User** and any **Sub-Regional TSO/Market Facilitator,** are subject to this **Code**. As per Article 2.1.8 of **GA**, **TSOs** are obliged to interface the prescription of this **Code** to the respective **National Grid Codes**.

In the spirit and within the limits of Article 3.2.6 of the **GA, TSOs** may grant temporary or permanent derogations, to be analyzed, case by case, to single users of their **Grids**, without prejudice to the overall performance that they shall guarantee with the adoption of this **Code**.

1.8 Frequency Control and Relevant Grid

Rules affecting the frequency control in a **Synchronous Area** apply to the whole interconnected area. To ensure the reliability of the interconnected operation, the rules concerning the load flow control at the borders apply to the **Relevant Grid.** The **Relevant Grid** is therefore the portion of the **TSOs' Grid** whose behavior affects the security of the neighboring **Grids**.

The extension of the **Relevant Grid** shall be agreed among the neighboring **TSOs**. The following aspects apply to the **Relevant Grid**:

a) The **Unavailability Plans**,
b) The **Contingency List**,
c) The **ATC/NTC** calculations,
d) The **Security of Operation** standards,
e) The **WAPS**.

1.9 Organization and Resources

J. As anticipated in the **General Agreement**, sketching an organizational structure is crucial to give concreteness to the application of the **Code**. The following is a proposal without prejudice of the **Committees** established at **General Agreement** level.

Pursuant to Paragraph 3.4.2.2 of **GA,** if the **Arab TSOs Committee** decides a different structure, the following **Committees** are recommended:

a) **C1-Operation Planning Committee** tasked with the coordination of operation planning. **C1**, in executing its duty can organize its activities by **Sub-Regions** or **Synchronous Areas**.
b) **C2-Operation Committee** tasked with **Real Time Control** and related issues. The scope of **C2** should include: control room activities, training of physical operators, **AGC**, protection settings, **WAMS**, **WAPS** and operating procedures.
c) **C3-ICT Committee** tasked with **ICT** matters and cybersecurity of the **SCADAs** and common **WAN** for operational data exchanges.

The above-mentioned **Committees** have no operational duties.

2 OPERATIONAL PLANNING

J. For the purposes of the market, the forecast of the **NTC** across the borders is as important as the forecast of the demand for **TSOs**. The assessment of **NTC** depends on the **Maintenance Plans** of the grids and the generation fleet. The complex interrelation among these factors requires coordination and optimization.

2.1 General Requirements

Member States shall keep the highest attention to the forecast activities and operation planning activities to cope with the high volatility of large volumes of energies moved by the **PAEM** operation, and to manage and prevent shortage periods. For this purpose, intense exchange of reliable information is required as well.

Based on forecast**, Member States** are responsible of providing the coverage of the demand and the amount of ancillary services that they must provide.

An **Operational Planning Process** (**OPP**) shall be adopted by each **TSO** and should include two basic parts:

a) The process internally to each **TSO.**
b) The coordination among all the **TSOs** of the same region.

The **OPP** shall guide the **TSOs** to issue the following:

a) The **Demand Forecast**,
b) The **Maintenance Plan** and the **Unavailability** (or Outage) **Coordination** of the elements of the **Relevant Grid**,
c) The **Maintenance Plan** and the **Unavailability** (or Outage) **Coordination** of the **Power-Generating Facilities**,

d) The **System Adequacy Forecast**.

TSOs shall repeat processing the same **OPP** variables on daily, weekly and annual basis, but with different focus as per next Sections.

2.2 Unavailability Coordination (Maintenance Requirements)

2.2.1 Unavailability

A high level of availability of the **Networks** is crucial for the security issues and for the development of the **PAEM**. Each **TSO** shall maintain its **Grid** and its **Synchronous Areas** according to the international practices and applicable **Good Utility Practices**.

TSOs are obliged to guarantee with the maintenance activity the regularity of the transmission services and the compliance with the applicable national laws.

TSOs shall:

a) not constrain the maintenance activity to services different from the electricity (e.g. optical fiber for public telecom service),
b) adopt efficient forecast and scheduling methods based on monitoring and historical data to increase efficacy of the maintenance processes,
c) provide timely first aid support and reparations in case of unpredictable failures,
d) be respectful of the environmental sustainability.

2.2.2 Maintenance

For the purpose of this **Code**, maintenance includes two categories the **Preventive Scheduled Maintenance** and the **Corrective Maintenance**[2]. The **Corrective Maintenance** can be in turn classified as:

a) Deferrable, if activity execution is performable at least one week later from anomalies detection.
b) Undeferrable, if activity execution must be performed within the week, to avoid dangers to people, equipment or toward fault situation.
c) After fault, if a reparation activity is needed as a consequence of a fault.

The elements of the **Relevant Grid** are subject to the coordination process of the **Preventive Scheduled Maintenance**. **Corrective Maintenance** is regulated on weekly basis.

2.2.3 Maintenance management guidelines

Each **TSO** shall schedule each intervention on the **Relevant Grid** with the following priorities as far as possible:

a) Concentrating the interventions in periods in which the **Energy Transfers** are statistically low,
b) Pursuing the objective of the maximization of the cross-border **NTC/ATC**.
c) Minimizing the down time of the elements of the **Transmission System**.
d) Avoiding causing more than once the same unavailability or the same capacity reduction for works that can be performed in parallel at the same time.

[2] See Cigré. Technical Brochure 660

e) Avoiding causing scheduled unavailability at specific borders in periods in which one or more of the **Interconnected Member States** is in under capacity regime and asked the **TSOs** of the neighbor **Interconnected Member States** for support.

Without prejudice to the respective **National Grid Codes**, **TSOs** shall assume the same priorities as per the **Relevant Grid** in the approval of the **Unavailability Plans** of the **Power-Generating Facilities**.

2.3 Demand Forecast

Demand Forecast is the primary input of the operation. All **TSOs** shall regularly publish the outcome of the forecast process.

TSOs should be able to perform the forecast of various kinds of demand for their **Control Area**:

a) The physical demand, losses included. That is the demand to be covered by the sum of all the active power supplied by the Power-Generating Facilities installed in the **TSOs Control Area** plus the cross-border **Energy Transfers**.
b) The demand covered by the conventional power generation and the one covered by the embedded power generation.
c) The demand covered by the market, i.e. the one covered by the day ahead market **Bids**.

The forecast shall be based on historical series of data. Hence, the **TSO** shall acquire power demand data from the **SCADA** and store them in operation databases according to the kind of demand to be calculated.

The measures acquired by the **SCADA** can be complemented by the ones acquired from the **Metering System**, especially for the embedded generation forecast and actual values.

The embedded power **RES**-based generation can be calculated adopting correlation methods.

The physical **Demand Forecast** shall be available at **Bidding Zone** and disaggregated at node level to allow load flow simulations for security evaluations.

In performing the duties related to the security, **TSOs** can size the ancillary services based on their own independent forecast, but they shall never voluntarily overestimate the demand to compensate a minor request of ancillary services or increase the security levels beyond the necessity.

2.4 Unavailability Planning

2.4.1 Coordination needs

At **Sub-Regional** level or **Synchronous Area** level, **TSOs** agree to fix the **Annual Maintenance Period** (**AMP**).

Within **C1**, the **TSOs** of the **Sub-Region** elect one of the **TSOs** of the **Sub-Region** or **Synchronous Area**, called **Area Coordinator of Planning** (**ACOP**). The ACOP may be a **Sub-Regional TSOs/ Market Facilitator**. In this case, and as far as the **Sub-Region** remains isolated, the involved **TSOs/ Market Facilitator** will present the conclusion of the plan of its

area (e.g. the Gulf Area as far as the internal grid is concerned, is processed and represented by **GCCIA**).

2.4.2 Yearly Unavailability Planning

Each year, three (3) months before the beginning of the **AMO**, **TSOs** shall forward to the **ACOP** the **National Annual Unavailability Plan** (**NAUP**).

Each **NAUP** shall guarantee that with reasonable hypothesis on the available import, the internal resources will cover the demand of each national **Electricity System,** guaranteeing the security of supply without jeopardizing the security of operation and notably the stability.

The **NAUPs** shall include optimized unavailability schedules of **Power-Generating Facilities** and **Relevant Grid** lasting more than a number of days agreed among **TSOs** of the **Synchronous Area.** Such a schedule should coordinate the interventions on the **Transmission System** with the ones on the **Power-Generating Facilities** fleet in order not to limit inefficiently the **Adequacy** and the **NTC/ATC**.

The **NAUPS** shall contain exhaustive information and details on every intervention. The information shall highlight at least the identification of the elements of the **Electricity System**, the nature of the intervention, its duration, the amount of MW and the estimated reduction of the **NTC/ATC**.

Information on the generation shall be in aggregated form, unless more detail is allowed by the **National Grid Codes** and agreed at regional level.

The **ACOP** and the representatives of each **TSO** of the **Sub-Region** shall collect and process the **NAUPs** as a whole with the objective of maximizing the **NTCs** border by border during the non-maintenance periods. The outcome of the process shall be the **Regional Annual Unavailability Plan** (**RAUP**).

The **RAUP** is approved by the **Arab TSOs Committee** under proposal of **C1** after iterations to guarantee the **Adequacy** of the **PAEM Electricity System** and published in an electronic bulletin edited by **C1** one month before the beginning of the **AMO**.

In case where **Adequacy** is at risk, alert procedures shall be applied, according to Section 2.8.

The **RAUP** shall be binding and deviations shall not penalize the **Sub-Regional TSOs / Market Facilitators** if not declared 3 months in advance.

The **RAUP** shall be the basis for the final identifications of the periods of the year when the **NTC** shall be reduced without penalties for the system services.

2.4.3 Weekly Update of the Unavailability Plan

Based on the yearly **Unavailability Plans**, **TSOs** adopt a weekly procedure for updating the **Unavailability Plan**. Adopting this procedure every week "*w*", the **TSOs** shall:

a) Take in the list the new interventions to be carried out from *w+3* to the end of the yearly plan.

b) Take into consideration the changes scheduled for *w+1* of those interventions already approved.
c) Cancellation of approved interventions.

Every week *w*, with the same procedure, **TSOs** handle the **Corrective Maintenance** schedule by taking under consideration the interventions allocated during *w+1* or *w+2*, considering the evaluations of urgency. The following steps should be applied:

a) Coordination shall be guaranteed by video call chaired by the **ACOP**.
b) Recommendations on safety shall be taken into consideration:
    i. pressure of market or continuity of supply never shall induce **TSOs** to infringe national safety rules and practices applicable on operation;
    ii. neighboring **TSOs** shall agree and be engaged to respect specific procedures for authorization before and after performing the maintenance works. They shall be in written form, with **Lock Out, Tag Out** (**LOTO**) techniques to guarantee earthing and general safety of workers.
c) Every Wednesday by 4 p.m. the updated **RAUP** is published in the electronic bulletin.

2.5 Adequacy Checks (Assessments)

Adequacy in each **Control Area** level is fulfilled when the demand is covered in energy and power at any hour of the period with the resources of import and internal generation available plus adequate reserve margins.

Adequacy checks are carried out at any iteration of the planning process are a prerequisite for the security of supply analysis and for the load curtailment decisions.

Assessments shall be based on reliable data, forecast and scheduling decisions at single **TSO**, **Synchronous Area**, **Sub-Regional** and at regional level, and will result from the combination of **Demand Forecast**, availability of **Power-Generating Facilities**, availability of the **Transmission System**, and the market conditions.

The coverage of the demand can be assessed by means of:

a) probabilistic methodology, till the fulfilment of pre-agreed levels of risk not to cover the load;
b) temporarily, by alternative simplified method transferring the risk to the amount of reserves to be kept available.

The probabilistic approach is preferable to disseminate the concepts of risks in planning and shall be put in operation no later than 2 years, after the date this **Code** enters into force. By the same deadline, the forecast adequacy assessments shall be based on the same definitions of the variables and comparable methodologies.

Ad hoc studies should support the simplified methods proving the relation between the amount of reserve needed and **Demand** and generation mix.

2.6 NTC Calculation

As per the **Scheduling & Dispatching Code** the annual **NTC** calculations are part of the annual schedule. To this purpose at least four (4) values of **NTC** for import and four (4) values for export across each border should be calculated, assuming that the **Transmission**

System is 100% available: peak and off-peak hour values in winter period (or other period to be agreed) and peak and off-peak hour values in summer period (or other period to be agreed).

In the annual period reductions of **NTCs** should be indicated in the days in which the **Relevant Grid** is intensely subject to maintenance. Annual values and days in which the **NTC** should be reduced, shall be published for the benefit of the market operation.

2.7 Reserve Margins Assessment

2.7.1 Reserve Procurement

Each **TSO** is responsible to keep under control and procure resources to cope with unavailability of **Power-Generating Facilities**, forecast errors and other probable events.

Reserves in operation are meant to be in both directions:

a) **Upward Reserves** defined as the differences between efficient power of generation available minus the peak load of the period, to be used to balance the **Electricity Systems** of the **Control Area** when the forecast shows that the load could be higher than the power generation.
b) **Downward Reserves** defined as the difference between the minimum load minus the sum of the technical minima of the **Power-Generating Facilities**, used to reduce the power generation when the minimum demand is expected to be lower than the minimum allowable power generation.

In the former case, the margins are called positive (**Upward Reserve**) while in the latter case they are called negative (**Downward Reserve**).

TSOs shall assess the need of **Downward Reserve** also in relation to the penetration of **RES** which are not programmable and sometimes not even possible to be curtailed in case of overestimation, if small size generators are spread and embedded in the **Distribution Systems**.

2.7.2 Reserves for the interconnected Operation

Electricity Systems of **Control Areas** may not be run without reserves even in times of shortage.

Reserve shall be divided in two categories:

a) **Reserves of Replacement** (**ROR**), i.e. the cold ones and the tertiary reserve non spinning.
b) **Reserves for Regulation** (**RFR**), i.e. the spinning reserves used for load – frequency control.

The need of both categories shall be verified in the yearly planning.

When the **Upward ROR** is less than a given threshold, the affected **TSO** shall warn the other **Members State** and open a discussion for studying countermeasures of support. In case of shortage and without prejudice to the **National Regulations,** the affected **TSO** should be supported by the rest of **TSOs** by increasing import and signing dedicated contracts. In case they were not sufficient, the affected **TSO** should be allowed to recover the missing amounts of **RFR** by applying the rotating load shedding available in its **Electricity System**.

When the **Downward ROR** is greater than a given threshold, the **TSO** may reduce the import after reducing the domestic power generation, unless inertia problems or voltage regulation problems arise. In this case **Dynamic Security Assessments** must be run, and the import should be reduced according to the priorities given by the regulations or when the reduction of internal resources hampers the functioning of the **Defense Plans**.

The amounts, and the share of reserves for regulation, are agreed among **Members States** of the **Synchronous Area**.

The evaluation of the needed **Replacement Reserves** highly depends on the standard deviation of the probability distribution, hence it depends, among others, on the lead time of the forecast. This should be the result of probabilistic approach. Nevertheless, close to real time simplified rules can be adopted for sake of readiness.

In both cases, a reference for the acceptable risk not to supply the load must be agreed at regional level.

Replacement Reserves should be calculated in terms of power, (MW) and verified in terms of energy (MWh) if from hydro resources or storage.

Non-programmable **RES** should not be included in the reserves.

2.8 Management of Shortage Crisis

J. Preventing shortage crises is the best way to avoid them. That is why by experienced **TSOs** will have to cooperate and jointly make the Best Effort to adopt also exceptional countermeasures. Crisis analysis can send price signals to the Market.

2.8.1 Main actions to cope with shortages

Each **Shortage** situation generates a crisis. In case of **Shortage**, the affected **TSO** shall warn the rest of the **TSOs** of the region as soon as possible. **C1** oversees the coordination of any possible action should support the affected **TSO**.

The **TSO** where there is shortage of reserve shall be ready to apply the rotating load shedding plan and warn other **Interconnected Member States**, if the cross-border support is not sufficient to solve the **Shortage**.

In case of crisis, the affected **TSO** can decide to suspend the market activities, if allowed by the applicable norms, cancel maintenance schedules, order the urgent and anticipated conclusion of unavailability of **Power-Generating Facilities** and / or **Grid** elements.

In exceptional situations and for a limited number of hours, the **C1** can allow to moderately derogate from **N-1** security and quality standards or loadability limits invoking **Emergency State** of the system to avoid the application of the rotating load shedding.

2.8.2 Further focuses in operation planning

The **Scheduling & Dispatching Code** deals with the operational planning matter.

Hereinafter some focuses are recalled.

a) In *w-1*, **TSOs** shall verify the adequacy and the expected load flows for the week *w*. A bulletin summarizing the unavailability, the expected demand, and the major expected issues shall be circulated among **Members States**. A weekly videoconference at regional level is considered a good practice to share timely actions in case of major criticalities.
b) In *d-2* the main activity concerning the cross-border relationships is the preparation of data on **Grid** and power generation, to calculate the **NTC** to be allocated in *d-1.*
c) In *d-2*, **TSOs** set up the **Individual Grid Model**, the confirmation of availability of the **Contingency List,** the associated **Remedial Actions,** and the generation shift for **NTC** calculations.

2.9 Seasonal Outlooks

Twice a year, in periods significant for the peak load, and falling in two different semesters, to be agreed within **C1**, each **TSO** shall perform dedicated **Seasonal Outlooks** aiming to predict and alert the **TSOs** of a region about potential issues, in terms of load coverage and alerting the **Market Facilitators** on what could be the framework.

Seasonal Outlooks shall be formulated at least as far as the scenarios of weather forecast and general energy crisis are concerned.

TSOs of a **Synchronous Area** or **Sub-Region**, within **C1**, elect and staff **Area Adequacy Coordinator** (**AAC**) to collect the **TSOs'** contribution and draft an outlook valid for the **Synchronous Area** where cross-border **Energy Transfers** and mutual support are highlighted.[3]

TSOs transmit to the **AAC** the **Seasonal Outlook** two months before the beginning of the considered period. [4]

Area Adequacy Coordinator collects the contributions and one month later issues a **Regional Seasonal Outlook** in which:

a) The single **TSO** reports are summarized country by country,
b) The mitigation plans of expected crisis are proposed and the contribution of cross-border **Energy Transfers** for mitigation of critical under capacity periods are highlighted,
c) The expected reserve margins available in the region,
d) The operation key risk indicators are assessed.

Once verified the potential risks, **C1** decides how often the framework must be monitored.

3 REAL TIME MONITORING AND CONTROL

[3] E.g. **GCCIA**, in quality of sub-regional **TSO/Market Facilitator** could present the conclusions of the **Seasonal Outlooks** related to the Gulf Area directly and on behalf of the Gulf **Members States**. In case of future interconnections between a GCCIA **Member State** and an external **TSO**, the **Seasonal Outlook** shall be integrated with dedicated sections.
[4] **GCCIA** is required to present the Gulf Area conclusions by 15 days before the same deadline.

J. The energy transition and the development of the market increase the complexity of the power systems in terms of volatility and new technical challenges like the lack of inertia. Modern **Electricity Systems** are compelled to keep the pass adopting enhanced tools, clear security standards and strong cooperation. This Chapter focuses on the minimum requirements of the tools and the most consolidated security standards.

3.1 Monitoring and Control Standard tools

Monitoring and control are based on various layers and require an efficient communication infrastructure. As far as this code is concerned, **TSOs** should comply with a minimum standard capability to monitor and control and they should adopt the same solutions as far as the **Relevant Grid**.

3.1.1 ICT platform

Information and Communications Technology (**ICT**) platforms are required for operational coordination among the **TSOs** of a **Synchronous Area**. At least for real time supervision and operational planning.

Considering the perspectives of expansion of the interconnection, all the Members States should adopt highly interoperable solutions with the same state of the art features.

The **ICT** platforms shall guarantee high dependability. Redundancy shall be guaranteed and alternative routing. Each **TSO** shall host two connections to the **TSOs** of the **Interconnected Member States**.

TSOs shall guarantee the widest interoperability at Pan Arab level. **TSOs** shall adopt protocols in common and aligned to relevant **Good Utility Practices**. **TSOs** shall take the engagement to cooperate for upgrading the **ICT** platform, whenever efficiency or interoperability is at stake.

In this regard active participation to the standardization bodies is recommended.

A dedicated, protected ITC structure is required to exchange operational data and real time information.

3.1.2 SCADA

TSOs shall adopt efficient, reliable and dependable system of **SCADA**.

As far as the interconnection is concerned, the **SCADA** shall import / export the statuses of the switchgears to reproduce the topology and the associated tele-measures of the **Relevant Grid** to guarantee the most efficient visibility. Visibility of the actions on the **Relevant Grid** shall be considered vital for coordinated and individual emergency actions.
General requirements of the **SCADA** shall concern:

a) Sampling period, as much as possible uniform (e.g. 2 – 4 sec) in the same **Synchronous Area.**
b) **LFC** as specified in this **Code**.

SCADA shall perform at least the following applications:

a) Efficient **HMI** and alarming systems.

b) Comparison forecast against actual at 15 minutes intervals of mean powers regrouped at various internal zone levels, at **Bidding Zone** level and total Control Area.
c) Dedicated displays for **RES** productions.
d) **State Estimator**.

SCADAs are subject to cybersecurity self-assessments at least to verify the security level and cyber risk across the **TSOs**.

3.1.3 Energy Management System (EMS)

The **EMS** is the package of application strongly connected to the **SCADA** encompassing complex computer-based tools designed to support the decisions of the **TSOs** in the control rooms.

TSOs shall adopt efficient **EMSs** according to the principle that the more efficiently they run their own **Electricity System** the more secure is the operation of the whole **PAEM Electricity System**.

It is recommended to include in the **EMS** package at least the following applications:
a) **N-1** security checks at time intervals between 5 and 15 minutes.
b) The **Dynamic Security Assessment**.
c) Command systems to record the dispatching orders to the **Power-Generating Facilities**.

Concerning the interconnection, the **EMS** shall include a **Warning System (WS)** to alert and make aware the **TSOs** simultaneously and in real-time the incoming or in progress criticalities. The **WS** shall consist in a synthetic display representing the **Control Areas** of the **Synchronous Area** with frequency, amount of actual cross-border flows compared with the scheduled ones and voltages in the pivotal nodes of the **Transmission System**.

3.1.4 Recording of the electrical behavior of the assets

In order to analyze the behavior of the **International Interconnections**, tie lines shall at least be equipped with **Fault Recorders** associated with the protection system and **Event Recorders** associated with the **Synchronous Area** of the substations.

The tie lines shall be equipped whit **Fault Locators**, in order to alert immediately the crews on the side of the border where the fault has occurred and accelerate the urgent repair activity.

It is recommended to complement the conventional monitoring system with **PMUs** in such a way to build up an efficient monitoring network of the dynamic phenomena in **Synchronous Areas**. The gathered data shall be shared among all **Member States** of the **Synchronous Area**.

3.2 Control room activity in National Control Centers

Neighboring **TSOs** are constantly in contact to control their **Control Area** and the interconnection 24 hours per day, 7 days per week. **National Control Centers** are the

corresponding entities entitled to take coordinated decisions about the interconnected operation.

In case of **Sub-Regional TSO/Market Facilitator,** the existing structure of control may apply as far as the **Sub-Region** is isolated. In case of connection with other systems, which do not apply to be part of the same **Sub-Region**, **TSO** and **Sub-Regional TSO/Market Facilitator** should comply with the **Code** in this matter.

Regarding real time control activities, neighboring **TSOs** shall:

a) agree on a common language if native ones are considered at risk of misunderstanding,
b) list in written form the most used and /or critical dispatching orders complete of descriptions in native languages and, if different from the common language agreed, in English,
c) agree on protocols to perform complex activities in autonomy under specific conditions (e.g. restoration sequences),

Neighboring **TSOs** shall reciprocally exchange the list of contingency and corresponding **Remedial Actions** available at the moment in order to allow security assessment.

TSOs guarantee the skill of their own physical operators and their diligent, professional attitude.

For protection of the behavior of the operator, without prejudice to labor laws and national regulation, it is recommended to record the telephone calls between operators, protect them and retrieve them only in case of formal inquiries. Notwithstanding the labor laws in each of the Members, a legal procedure is needed to tackle this matter correctly.

In real time **TSOs** of a **Synchronous Area**, among others, shall:

a) Exchange the **Individual Grid Models** and merge them in a **Common Grid Model** for networks analysis.
b) Perform at regular intervals the security analysis.
c) Manage the **LFC** and the balancing reserves.
d) Warn as soon as they can, about criticalities arising in their **Control Area**.
e) Perform the **Restoration Plan** in cooperation with the neighboring **TSOs**.

3.3 Operational Security

3.3.1 Loadability and Operational limits

Operating ranges for **Power-Generating Facilities** and **HVDC Systems** are specified in the **Connection Code**. They can be determined by physical characteristics (loadability limits) or by conditions of the systems if more stringent of the previous ones. Operational limits can be permanent and transient.

3.3.2 Operation Security Standard (OSS)

The following apply to the **Relevant Grid** as far as voltage and currents are concerned, and to the whole **Synchronous Area** as far as frequency / balancing are concerned.

As regard to the security of operation, each interconnected **Electricity System** continues to work within its permanent admissible limits of voltage, frequency and current in any part of it, after a contingency, of a given **Contingency List,** occurred and its effects are faced by applying proper **Remedial Actions**. Between the occurrence of the contingency and the **Remedial Actions,** the permanent limits may be exceeded, but they shall be kept below the transient acceptable limits for a given length of time. This state of functioning of the **Electricity System** is also called **Normal State**.

As regard to the security standard, means that **TSOs** shall guarantee the security of operation if an element of the **Electricity System** at the time is lost and more precisely if a contingency from an agreed **Contingency List** occurs and ad hoc **Remedial Actions** are applied. Load shedding cannot be included in the **Remedial Action** list, unless a contract states this possibility. Without prejudice to the applicable national regulation in matter of market, cross-border **Energy Transfers** should be the last to be reduced in the **Remedial Actions** list.

TSOs shall also strive for the resilience of the **Electricity System** in case of occurrence of multiple contingencies or contingencies more severe than the ones in the **Contingency List**. To this purpose, **Defense Plan** and **Restoration Plan** are designed and applied to counteract such an event limiting its consequences in severity and duration.

TSOs shall assess the security conditions applying methods under their responsibility, but reflective of verifications in steady state and transient conditions.

3.3.3 Contingency analysis and Remedial Actions (security assessment)

TSOs shall perform regular network studies to analyze the effects of contingencies on security of the **Electricity Systems** of the **Interconnected Member States**. Such contingencies shall concern trips of **Grid** elements, outages of **Power-Generating Modules** or injection of power, loss of loads or withdraw of power.

TSOs shall group contingencies in three categories: *normal*, *exceptional*, *out of range*.

The Normal contingency list includes trips of single lines or double circuit lines, single transformers, loss of a single **Power-Generating Modules**, a single DC link both in import and export, with a subsequent imbalance lower than the **Reference Incident**, being the **Reference Incident** the largest loss of load or generation that could happen as a single event in the area. Each **TSO** has the right to include the simultaneous trip of the double circuit lines in the category of *Normal* contingency on the base of the protection and the percentage of length on the same towers.

The *Exceptional condition* list includes multiple contingencies with a common cause (e.g. a fault between a CT and a CB triggering the breaker failure protection).

The *out of range contingency* list includes the simultaneous occurrence of multiple contingencies even without functional common causes (e.g. caused by exceptional weather conditions) followed by loss of generation, load and other major catastrophic consequences.

Against each contingency list, each **TSO** shall study the countermeasures that manually or automatically manages to adopt in order to avoid the **Electricity System** to work out of its limits.

To each normal contingency, the responsible **TSO** shall study a countermeasure called **Remedial Action** able to restore the security of the system after the occurrence of the contingency. Such countermeasures form the **Remedial Action List**. **TSOs** shall adopt the N-1 security standard which means that to normal contingency there is an available remedial cation able to bring back the electricity system within the operative limits.

Against the occurrence of the exceptional or out of range contingencies, **TSOs** shall adopt **Defense Plans** to counteract as much as possible such incidents, minimizing the loss of load and minimizing entity and duration of the power cuts.

Notwithstanding the right of each **TSO** to decide what is the best operation rules for its **Electricity System**, transparent and technically consistent criteria for security assessment and adopted tools should be shared at **Synchronous Area** or **Sub-Regional** level at least. Even if different, they shall be declared and technically discussed

3.3.4 System States

Despite their high dependability, the Interconnected systems could pass from a Normal State, as defined above, to another where the security of operation is not guaranteed. Hereinafter, the *de facto* standard rank[5] of such states is reported together with the associated definition, identification, special powers given to the **TSOs**, inter **TSOs** cooperation and actions to bring the **Electricity System** back to a secure state.

In **Alert State**, the interconnected **Electricity System** is still within acceptable limits, but no resource is available to cope with a contingency of the **Contingency List**. The affected **TSO** shall timely warn all the **Interconnected TSOs** of the results of the security analysis if a contingency in its **Control Area** could cause cascading in the neighboring **Control Areas**.

In **Emergency State**, the interconnected **Electricity System** is deteriorated, because the operational limits are no more fulfilled and **Grid** splits or power cuts could be in progress. In this state, the risk for the **Electricity Systems** of **Interconnected Member States** is considered high. Security standards cannot be fulfilled by the affected **TSO** and ordinary **Remedial Actions** would result without effects. The affected **TSO** shall warn continuously the **TSOs** of the region and ask for support.

TSOs of a region, agree on the identification of blackout in terms of extension and maximum time to identify it. It is commended to make a difference between an ordinary power cut (local and controllable) and a blackout, characterized by the total absence of voltage in large areas of the **Electricity System** of a **Member State**, involving the bulk **Electricity System** and lasting more than 5 minutes. In case of blackout and under request of the affected **TSO**, the **Restoration Plan** is triggered and the neighboring **TSOs** shall cooperate to the re-energization. Safety rules are unbreakable, and the market activities are suspended.

[5] Classification commonly used in Europe (UCTE and EN**TSO**-E) and in Cigré.

3.3.5 Stability studies

Regular security assessments are network analyses performed in steady state regime by mean of AC load flow calculation. This is considered acceptable in the **Good Utility Practices** as long as the transient acceptable limits are more stringent than the ones deriving from a complete stability study. If not, the transient acceptable limits shall be reduced by the **TSO**.

Stability studies shall include transient stability, dynamic stability and voltage collapse. **TSOs** shall run such studies periodically. The methodology to set up dynamic **Common Grid Models** should be ready in two year since the date of entering into force of this **Code**.

TSOs shall perform stability studies to assess the security:

a) To design the **Defense Plans**, in case of contingencies more severe than the ones of the **Contingency List**,
b) In case of multiple contingencies, to verify the needs or the sufficient amount of **Defense Plans**,
c) In the particular cases where the inertia is considered scarce or the transmission distances increase due to the displacement of generation respect to the loads.

3.4 Operational Reserves and load/frequency control management

TSOs shall make available enough active power reserves to keep the total cross-border **Energy Transfers** constantly at the scheduled values and frequency in the **Synchronous Area** at the nominal frequency, according to sharing principles and taking into account the evolution of the **Synchronous Areas**.

Reserves and their characteristics (e.g. in terms of promptness and duration) shall aim at keeping the quality targets as much as possible under control

In the following Articles, default values are prescribed, without prejudice to different solutions agreed and formalized in written form in the same **Synchronous Area**.

3.4.1 Frequency Containment Reserve (Primary)

The total need of **FCR** in the **Synchronous Area** shall be not less than the power associated to the largest single incident in both directions: loss of infeed and loss of outfeed.
Each **TSO** shall contribute to share pro quota the unbalances in the **Synchronous Area** based on the average power production of the **Member State** divided the average production of the **Synchronous Area**. **C2** shall calculate the share of each **Member State** every year on the base of the largest incident that can occur in the **Synchronous Area** as a single event.

Inter **TSO** of the same **Synchronous Area** and referring to the same **Sub-Regional TSO/Market Facilitator** may agree on different shares.

FCR shall respond to frequency deviations without intentional delays and in such a way to exhaust the whole amount in 30 seconds. The full power shall be supplied for 15 minutes at least. In case of deviation lasting more than 15 minutes, **TSOs** shall not reduce their contribution voluntarily.

3.4.2 Frequency Restoration Reserve (Secondary)

According to the general principle that each **TSO** of a **Synchronous Area** shall compensate unbalances in its **Control Area**, each **TSO** shall make available an amount of power needed

to compensate errors in **Demand Forecast** to bring back the frequency to its nominal value, the loss of the largest unit (upwards) or the loss of load (downwards) and the **Demand Forecast** errors.

TSOs of the same **Synchronous Area** shall agree on the methods of calculation of such amounts. In case of no agreement, they shall apply a probabilistic approach fixing the target to have sufficient resources in 99.9% of time.

TSOs shall modulate the **FRR** resources by mean of a **Load Frequency Controller**. Only in particular cases **FRR** can be carried out manually.

3.4.2.1 LFC minimum requirements

The **LFC** shall be proportional – integral type driven in input by the (area Control Error) i.e. a linear combination of system frequency deviation and power deviation, according to the following:

$$ACE = \triangle P + k \triangle F$$

In 30 seconds, the **LFC** must start to reduce till zero the **ACE** as soon as possible but no later than 15 minutes without overshooting.

The cycle time of the **LFC** shall be set between 1 and 5 seconds.

k factor is calculated each year as a percentage of the total regulating energy of the **Synchronous Area.**

3.4.2.2 Reserve Replacement (Tertiary)

RR size is the same order of magnitude of the **FRR**, being used for replacement when the unbalance lasts more than a given time.

The **LFC** minimum requirements of Paragraph 3.4.2.1 are subject to be adapted by agreements at **Synchronous Area** level and managed by the **Sub-Regional TSO/Market Facilitator.**

At the date of this **Code**, **Synchronous Areas** are:

a) Maghreb Area, synchronous with Europe (Morocco, Algeria, Tunisia).
b) Central Area (Lebanon, Syria, Iraq, Palestine, Jordan, Egypt, Libya).
c) GCCIA 50 Hz (Kuwait, Bahrain, Qatar, U.A.E. and Oman).
d) GCCIA 60 Hz (Kingdom of Saudi Arabia).

*3.4.2.3 Main characteristics of the **Synchronous Areas**.*

Table 3-1 shows the main characteristics of the **Synchronous Areas**.

Table 3-1. Frequency Quality Targets

Parameter	**Synchronous Area Maghreb (1)**	**Synchronous Area Central**	**GCCIA 50 Hz (2)**	**GCCIA 60 Hz (2)**
Standard frequency range	±50 mHz	**tbc**	**tbc**	tbc

Max instantaneous deviation	800 mHz	**tbc**	**tbc**	tbc
Max steady state deviation	200 mHz	**tbc**	**tbc**	tbc
Time to recover frequency	1 min	**tbc**	**tbc**	tbc
Time to restore frequency	15 min	**tbc**	**tbc**	tbc
NOTE: (1) Same as the Continental Europe (2) Same region regulated by GCCIA grid **Code**. Split for the frequency regulation only				

Table 3-2. Low frequency disconnection

Parameter	**Synchronous Area Maghreb**	**Synchronous Area Central**	**GCCIA 50 Hz**	**GCCIA 60 Hz (*)**
Starting disconnection low frequency	49 Hz	**tbc**	**tbc**	**tbc**
Final disconnection low frequency	48 Hz	**tbc**	**tbc**	**tbc**

Table 3-3. Other parameters

Parameter	**Synchronous Area Maghreb**	**Synchronous Area Central**	**GCCIA 50 Hz**	**GCCIA 60 Hz (*)**
Reference incident	3000 MW	**tbc**	**tbc**	**tbc**
Regulating Energy (overall network power frequency characteristic)	27,000 MW/Hz	**tbc**	**tbc**	**tbc**

The **Time Control** is dealt in the **Scheduling & Dispatching Code** in Chapter 7.

4 NETWORK PROTECTION AND DEFENSE PLANS

J. For the same reasons stated in Chapter 3, the interconnection becomes more complex than before when ordinary faults or complex contingencies occur. Strict rules of coordination of automatic tools of protection and control are the best guarantee to support members of the same **Synchronous Area** and be supported by neighboring **TSOs**.

Each **TSO** should be aligned to the protection standards as far as the whole bulk system is concerned and should transfer the obligations on requirements to the **Users** of the **Grid**. **TSOs** of **Interconnected Member States** shall stipulate for each tie line a **Connection Agreement** (**CA**) regulating, among others, management of the protection.

This **Code** prescribes the requirements of the protection system leaving the practical solutions to the responsibility of the **TSOs**.

4.1 Protection devices against faults

Fault clearing time shall be the minimum between the requirements prescribed in the **National Grid Codes** of the **TSOs** of **Interconnected Member States**. **TSOs** specify the clearing times with and without circuit breaker failure which should never exceed 80 and 240 milliseconds.

Selectivity must be guaranteed. Busbar and breaker failure protections are prescribed at the sending and ending substations of the tie lines.

Redundancy shall be prescribed by back up or *main 1, main 2* at local level and by remote in case of faulty elements of the chain of the main protection system.

Automatic reclosing functions with and without synchro check are recommended. Agreements shall be made in terms of number of shots, poles (three or single pole) and adoption close to generators, pursuant to respective **National Grid Codes**.

The **Relevant Grid** should be at the same protection standard level.

4.2 Procedures

The **Connection Agreement** shall contain the full protection schemes. Any change of them shall be agreed in advance and properly recorded.

The **Connection Agreement** shall include:

a) Setting coordination that shall be carried out jointly, according to coded procedures.
b) Maintenance procedures (what kind, periodicity, repairing and replacement of devices or parts of them.
c) Tele-protection testing and channel rents.

4.3 Defense Plan Coordination

The actions exclusively dedicated to limit the consequences of major disturbances whose severity goes beyond the effects of the contingency, in the **Contingency List,** and impossible to prevent in normal operation are defined in **Defense Plans**. No other use of **Defense Plans** is acceptable.

Defense Plans include: the load shed by frequency deviations or by voltages in conditions close to voltage collapse, **PSS** to damp dynamic stability problems and **WAPS** to control overload of lines

In security assessment procedures, also exceptional contingencies and the efficacy of the **Defense Plans** must be simulated.

In case of lack of available resources for the **Defense Plans** in daily operations, **TSOs** are required to inform other **TSOs** of the region / **Synchronous Area** and are allowed to take measures, including the reduction of the **Energy Transfers**.

4.4 Wide Area Protection Systems (WAPS)

WAPS are allowed if they are designed and carried out under strict requirements of dependability (availability when needed) and security (no operation when not needed).

Given the devastating effect that a maloperation of the **WAPS** could have, **TSOs** shall:

a) apply severe procedures to monitor and authorize the status of on / off of a **WAPS** in the **SCADA**.
b) Prescribe the adoption of warnings in the substations, on board of the cubicle where **WAPS** are installed and the circuitry.

WAPS are allowed if they pursue the goal of saving the integrity of **International Interconnections** against exceptional or out of range events. Typical is the case of interruptible load shedding to avoid a line to trip for overload.

WAPS for purposes not for saving **International Interconnections** should never count on trip of elements or change topology of a **Grid** for events that occurred in the **Control Area** of another **TSO**.

Events in an **Electricity System** of a **Member State** triggering the operation of **WAPS** shall never shed the load or the generation in an **Electricity System** of another **TSO** (or cause imbalances) unless specific and clear agreements are signed.

Position of circuit breaker and switches shall be made visible to the neighboring **TSOs** that wants to associate a **WAPS** to the topology of the Grid of the **Interconnected Member States**. In this case, maintenance control and cautions to avoid unwanted operation of the **WAPS,** must be guaranteed and dedicated agreements must be signed.

Responsibility remains of the **TSO** who designs, proposes and manages the **WAPS** of its competence.

WAPS schemes shall be confidential but shared among the **TSOs** for correct dynamic simulations.

4.4.1 Underfrequency Load Shedding (UFLS)

Frequency thresholds shall be within the limits of frequency agreed in Paragraph 3.4.2.3. divided at least in 6 steps, unless specific studies show other values. Pumping storage plants can be shed before reaching the upper frequency limit.

Load shedding should be implemented in the following order: pumping storage first, then interruptible load, industrial load and residential load last.
The essential services like hospitals, civil and military protection facilities, as better defined by National Public Authorities, should be never subject to load shedding.

Reducing the power flows across the border should be regulated by agreements among all the **TSOs** of a **Synchronous Area.**

In sizing and designing the **UFLS** plan, probable system splits have to be taken into consideration as events to cope with.

The share of load available to shed for generalized frequency decays should be proportional to the peak load of the **Member State**.

UFLS plans should be revised when a) new **TSOs** are connected to a **Synchronous Area,** or two or more **Synchronous Area**s merge and b) every three (3) years.

4.4.2 Manual load shedding

Manual load shedding practice can complement the **Defense Plans** in:

a) Balancing the system.
b) In a rotating way, to share the discomfort in case of power cuts lasting more than the average.

PSSs are part of the **Defense Plans** for damping low frequency oscillations. A revision of settings shall be performed before a new system is added to a **Synchronous Area** or two **Synchronous Area**s are merged

5 EMERGENCY AND RESTORATION

J. Solidarity and operating advantages in accelerating the service find concrete application in the restoration. Restoration could mean in fact the recovery of internal loads and the reconnection with the rest of the **Synchronous Area**. Being prepared and coping with rare but possible undesirable events requires joined experience, common simulations and training.

5.1 Emergency Procedures

The terms of cooperation shall be inspired by the sense of solidarity first, but terms and limits of cooperation shall be concretely agreed in specific procedures and multilateral agreements by the **Member States.**

Alert procedures and tools shall aim at spreading the knowledge on the state of the **Synchronous Area** timely and securely among all the **TSOs** of **Interconnected Member States**. To this purpose:

a) in addition to the **Warning System**, each control room shall communicate and have access to **Contact Lists**, with names of physical operators, telephone numbers and position to contact in case of need.
b) Secure and protected communication channels (telephone, fax, e-mail).
c) Make aware, preferably with formatted messages, the state of the system, the expected duration of the emergency and request of support.
d) Facilitate the crisis management at least avoiding that involuntary actions of one **TSO** could worsen the status of an Electricity System of another **Member State**.

Open crisis permanent conference during emergency among all the **TSOs** of the same **Synchronous Area** should be common practice, previously agreed in the modalities and tested periodically.

5.2 Restoration Procedures

Fulfilment of security standards affect the reduction of risk and must be pursued systematically. In case of out of range contingencies, after the **Defense Plan** activations, fundamental contribution to the resilience is given by a fast and efficient **Restoration Plans**. Cooperation shall be granted by **Interconnected Member States** in case of adoption of top down re-energization procedures in case that the affected **TSO** is split from the rest of the **Synchronous Area**.

On request of a **TSO** of the **Synchronous Area**, re-energization paths shall be designed from across the border from the **Electricity System** insecure conditions to supply voltage and contribute to stabilize frequency during reconnection of load and generation in the affected portion of **Transmission System**. In designing such procedures, **TSOs** shall take into consideration the effects of the automatic reconnection of the embedded **Power-Generating Facilities** triggered by the frequent thresholds.

In case of split of the **Synchronous Area** in two or more zones, at the end of transient regime, if the frequency is stabilized after the operation of the **Defense Plans**, **TSOs** shall cooperate in bringing back the system to normal frequency.

To this purpose, coordination plays a crucial role in terms of:

a) Freezing the **LFC** and at which frequency **TSOs** must balance their **Grid** manually.
b) Electing a **Frequency Leader** with enough installed and capacity to make available.

The **Frequency Leader** shall operate its **LFC** in frequency and coordinate the balancing steps of the other **TSOs** until the frequency comes back within a given tolerance. The **Frequency Leader** orders when the other **TSOs** shall switch back the **Control Area** regulator to **LFC** mode. The **Frequency Leader** is the last to do so.

In case of reconnection of two **Islands**, a **Resynchronization Leader** is elected. In general, the affected **TSO** is chosen. The **Resynchronization Leader** reduces the **Frequency Leaders** to one and gives orders to resynchronize.

6 DATA AND INFORMATION EXCHANGE

J. Reporting the analysis of the operational facts and figure is not an exercise of media communication. It is the opportunity to enter common data experiences, interpretation of root causes of events and quantitative elements helpful for improving the operation. Statistics are an important heritage of the day-by-day operation for future choices and decisions

General applicable rules to data exchanges, formats and supports are reported in the **Data Exchange Code**. Hereinafter recommendations on reporting and statistics are reported.

6.1 Annual Operation report

The aim of the annual report is to promote among **Member States** and external entity the value of interconnection, highlighting progress in operation and market.

Notwithstanding the policies and obligations on confidentiality, **TSOs** shall cooperate to regularly issue the annual operation report at Pan Arab level with details of **Synchronous Area** and isolated **TSOs**. The content should cover, complete of year-over-year differences:

a) Demand in energy and power;
b) Amount of exchanged energy border-by-border;
c) Production balances per source;
d) **RES** penetration progress;
e) Relevant facts and events including major disturbances.

C2 shall coordinate the data collection and drafting activity for issuing a quarterly report on frequency and power exchanges.

6.2 Data for statistics

Statistics are the basis of forecast both in operation and planning. Historical data shall be stored in the common data base and maintained by the **TSOs** themselves.
The collection of statistical data shall be done regularly and certified. Any change after collection shall be registered and approved.

7 TESTING AND PERFORMANCE MONITORING

J. Periodic tests is crucial for the reliability of the PAEM Electricity System. It has to be reminded and become a traceable and transparent obligation.

It is a fact that **TSOs** take commitments towards the other **TSOs**, but they have to be supported internally to reinforce the obligations they take. To this purpose, notwithstanding the obligations given by the single **National Grid Codes**, **TSOs** shall be supported towards external third-parties in:

a) Testing **Restoration Plans**, including **Black-Start Capabilities** of **Power-Generating Facilities** and reconnections of **Demand Facilities**, have to be tested periodically.
b) Testing emergency procedures.
c) Inspecting **Power-Generating Modules** and **DSOs** to ascertain the accomplishment of their duties in matter of frequency regulation.

8 TRAINING AND CERTIFICATION

J. Modern trend require continuous training and certification of the operators. In particular, the joint training involving neighboring **TSOs** and **Sub-Regional TSOs/Market Facilitators** is of paramount importance.

Selection of the appropriate skilled personnel employed as operators in **National Control Centers** and operation planner is responsibility of **TSOs**.

Physical operators should have a degree of Technician or above in power system-related topics. Before having access to the control room of the **National Control Centers,** and assume operational responsibility, they should have had:

a) Successfully passed psycho attitudinal tests.

b) Class on theory on components, **Electricity System** structure, market, network analysis, protection and automation, **HVDC System** technology, safety, environmental protection.
c) On site visits to substations, lines and other facilities.
d) Training on the job for six (6) months at least.

For the personnel already in service **TSOs** shall certificate their competences, after providing them with training hours on the operation topics. The HR department of the **TSOs** should register the number of given training hours.

TSOs shall organize joined inter-**TSO** training sessions at least among neighboring **TSO** operators and **Regional Coordinator Operators**.

TSOs shall commit themselves to give at least 350 hours pro capita per year in refreshing and updating sessions.

9 CYBERSECURITY

The bulk power system shall be considered a mission critical infrastructure by the **Member States**. As such the cybersecurity of the single **TSO** of the interconnection shall comply with the respective national policies and their confidentiality requirements.

As far as the ICT infrastructure in common adopted to exchange operational data on real time and operational planning are concerned, **C3** shall issue guidelines including:
a) The self-assessment of the vulnerability and resiliency capabilities proven by resilience tests.
b) The analysis of cyber threat scenarios, risk assessment and security plans.
c) The organization of physical mitigation measures.
d) Procedures of response to attacks.

TSOs shall self-certify the application of requirements (holistic approach) about physical and functional segregation, and access control to structures and applications to infrastructures in common for operation.

10 EXEMPTIONS

The **TSO** claiming exemptions shall apply for it to the **Sub-Regional TSO/Market Facilitator** specifying which articles and attaching a technical report on the reasons.

Sub-Regional TSO/Market Facilitator, after discussions with the **TSOs** of the same **Sub-Regions**, will transfer to and involve the **Committees C1** or **C2** or **C3** according to the matter.

The involved **Committee** shall discuss the matter.

Granting the exemption shall never be discriminatory, never damage any **TSO** of the **Synchronous Area** and has to be justified by solid technical reasons. **C1** shall evaluate if an exemption can be extended automatically to other subjects in the same conditions.

Exceptions have to be recorded in a register and **Published**.